CLAIMS

The principles of this invention having been fully explained in connection with the foregoing, I hereby claim as my invention:

1. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a switch for disconnecting said auxiliary winding from said AC source, an improved control circuit for said switch comprising

main voltage detector means for sensing the magnitude of the AC main winding voltage,

main voltage zero crossing detector means for sensing the points at which main winding voltage polarity is instantaneously reversed,

window pulse generating means for generating a pulse at the points at which main winding voltage polarity is reverse,

auxiliary voltage detector means for sensing the magnitude of the AC auxiliary winding voltage,

voltage comparator means for sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

auxiliary current zero crossing detector means for sensing

the points at which auxiliary current flow changes direction, and

phase comparator means for sensing the phase shift between the main voltage zero crossing points and the auxiliary current zero crossing points,

wherein said phase comparator means operates to disconnect said auxiliary winding when the phase shift of the auxiliary winding current zero crossing falls within the main voltage pulse as a function of motor speed.

2. The control circuit of claim 1 wherein said voltage comparator means operates to connect or reconnect said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor load and motor speed.

3. The control circuit of claim 2 wherein said voltage comparator includes pulse shape generating means for generating a first logic pulse and said phase comparator includes pulse shape generating means for generating a second logic pulse.

4. The control circuit of claim 3 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

5. The control circuit of claim 4 wherein said switch comprises a triac device that is triggered by a negative voltage value.

6. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a switch for disconnecting said auxiliary winding from said AC source, an improved method for controlling said switch comprising the steps of

sensing the magnitude of the AC main winding voltage,

sensing the points at which main winding voltage polarity is instantaneously reversed,

generating a pulse at the points at which main winding voltage polarity is reversed,

sensing the magnitude of the AC auxiliary winding voltage,

sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

sensing the points at which auxiliary current flow changes direction, and

sensing the phase shift between the main voltage zero crossing points and the auxiliary current zero crossing points,

wherein said phase shift operates to disconnect said auxiliary winding when the phase shift of the auxiliary winding current zero crossing falls within the main voltage pulse as a function of motor speed.

7. The method of claim 6 including the step of connecting or

reconnecting said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor load and motor speed.

8. The method of claim 7 including the steps of generating a first logic pulse as a result of voltage comparison and generating a second logic pulse as a result of phase comparison.

9. The method of claim 8 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

10. The method of claim 9 including the step of providing a triac device that is triggered by a negative voltage value as the switch.

11. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a swithch for disconnecting said auxiliary winding from said AC source, an improved control circuit for said switch comprising

main voltage detector means for sensing the magnitude of the AC main winding voltage,

main voltage phase detector means for provision of a reference for phase comparison of main winding current phase sensing.

auxiliary voltage detector means for sensing the magnitude

of the AC auxiliary winding voltage,

voltage comparator means for sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

auxiliary current phase detector means for measuring the main winding phase shift, and

phase comparator means for sensing the phase shift between the main voltage and the main winding current,

wherein said phase comparator means operates to disconnect said auxiliary winding when the phase shift of the main winding falls within a predetermined value of the phase relative to the main voltage as a function of motor speed.

12. The control circuit of claim 11 wherein said voltage comparator means operates to connect or reconnect said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor speed.

13. The control circuit of claim 12 wherein said voltage comparator includes pulse shape generating means for generating a first logic pulse and said phase comparator includes pulse shape generating means for generating a second logic pulse.

14. The control circuit of claim 13 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

15. The control circuit of claim 14 wherein said switch comprises a triac.

16. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a switch for disconnecting said auxiliary winding from said AC source, an improved method for controlling said switch comprising the steps of

sensing the magnitude of the AC main winding voltage,

sensing the points at which main winding voltage polarity is instantaneously reversed,

generating a pulse at the points at which main winding voltage polarity is reversed,

sensing the magnitude of the AC auxiliary winding voltage,

sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

sensing the points at which main current flow changes direction, and

sensing the phase shift between the main voltage zero crossing points and the main current zero crossing points,

wherein said phase shift operates to disconnect said auxiliary winding when the phase shift of the main winding current zero crossing falls outside the main voltage pulse as a function of motor speed.

17. The method of claim 16 including the step of connecting or reconnecting said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor speed.

18. The method of claim 17 including the steps of generating a first logic pulse as a result of voltage comparison and generating a second logic pulse as a result of phase comparison.

19. The method of claim 8 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

20. The method of claim 9 including the step of providing a triac device that is triggered by a negative voltage value as the switch.

21. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a switch for disconnecting said auxiliary winding from said AC source, an improved control circuit for said switch comprising

main voltage detector means for sensing the magnitude of the AC main winding voltage,

main current phase detector means for provision of a

reference for phase comparison of auxiliary current phase sensing.

auxiliary voltage detector means for sensing the magnitude of the AC auxiliary winding voltage,

voltage comparator means for sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

auxiliary current phase detector means for measuring the auxiliary winding phase shift, and

phase comparator means for sensing the phase shift between the main current and the auxiliary current,

wherein said phase comparator means operates to disconnect said auxiliary winding when the phase shift of the auxiliary winding current falls within a predetermined value of the phase relative to the main winding current as a function of motor speed.

22. The control circuit of claim 21 wherein said voltage comparator means operates to connect or reconnect said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor speed.

23. The control circuit of claim 22 wherein said voltage

comparator includes pulse shape generating means for generating a first logic pulse and said phase comparator includes pulse shape generating means for generating a second logic pulse.

24. The control circuit of claim 23 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

25. The control circuit of claim 24 wherein said switch comprises a triac.

26. In an AC motor having a main winding and an auxiliary winding both connectable to an AC power source, and having a switch for disconnecting said auxiliary winding from said AC source, an improved method for controlling said switch comprising the steps of

sensing the magnitude of the AC main winding voltage,

sensing the points at which main winding voltage polarity is instantaneously reversed,

generating a pulse at the points at which main winding voltage polarity is reverse,

sensing the magnitude of the AC auxiliary winding voltage,

sensing the difference in voltage magnitude between the main winding and the auxiliary winding,

sensing the points at which the main current flow changes direction,

sensing the points at which auxiliary current flow changes direction, and

sensing the phase shift between the main current zero crossing points and the auxiliary current zero crossing points,

wherein said phase shift operates to disconnect said auxiliary winding when the phase shift of the auxiliary winding current zero crossing is within a predetermined time relative to the main current zero crossing as a function of motor speed.

27. The method of claim 26 including the step of connecting or reconnecting said auxiliary winding when the magnitude of the voltage of the auxiliary winding decreases below a predetermined value relative to the magnitude of the voltage of the main winding as a function of motor speed.

28. The method of claim 27 including the steps of generating a first logic pulse as a result of voltage comparison and generating a second logic pulse as a result of phase comparison.

29. The method of claim 28 wherein said first and second logic pulses are used by a logic controller to turn said switch on and off.

30. The method of claim 29 including the step of providing a triac device that is triggered by a negative voltage value as the switch.